

Can you 3D Print a Centrifuge to Enrich Uranium?

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In a presentation at the ESARDA 2015 conference [today](#) in Manchester I reviewed the possibility of 3D printing centrifuges used to enrich uranium. The use of 3D printing in aerospace is a good bellwether for centrifuges as both industries require high-quality, high-specification and high-strength material. Tellingly, aerospace manufacture has recently begun to transition from prototyping to [direct parts production](#).

There are only a few materials strong suitable for use in manufacturing centrifuges for enriching uranium, due to the high speeds of operation. Of these, carbon fibre isn't suitable for 3D printing; but high strength aluminium and maraging steel [are](#).

Printed aluminium doesn't appear to be strong [enough](#) but the maraging steel [is](#), when looking at requirements on ultimate tensile strength from the [NSG dual use list](#). However, maraging steel gains its strength from age hardening, so any parts 3D printed using maraging steel powder would require additional post production manufacturing steps to achieve the required hardness.

In short, with appropriate steps, you can print centrifuge components with [off the shelf 3D printers](#). However, it might not work: even with precision of [about 40 um](#) between layers the post printing polishing step needs to be incredibly precise. Also, current machines can only print small components, and 3D printing takes many days per component. This is not to mention the price: current machines cost about ¾ million USD. Most importantly R&D into the quality of 3D printed metals is still being [performed](#), but this will likely cease to become a barrier if it hasn't already.

The nuclear industry is unlikely to start producing centrifuges with 3D printed components anytime soon due to current limitations on time and cost associated with this technology. However, neither 3D printers nor maraging steel powder are currently export controlled. This leaves the possibility open for states covertly attempting to

procure items for a nuclear programme. This is a clear gap in the export control regime and advances in 3D printing are only likely increase the probability the regime will be circumvented by 3D printers as time progresses.